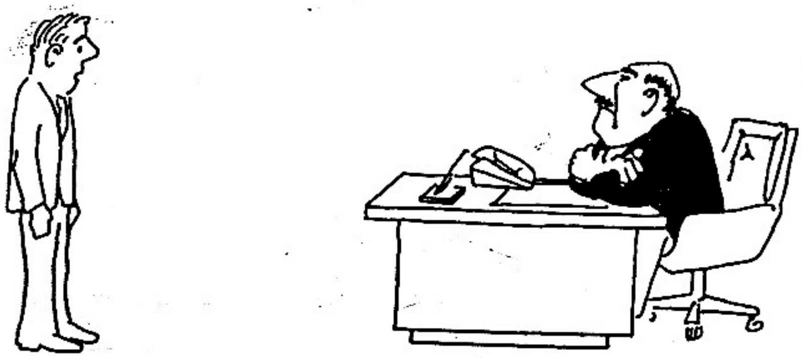
Handzettel aus: Garey & Johnson

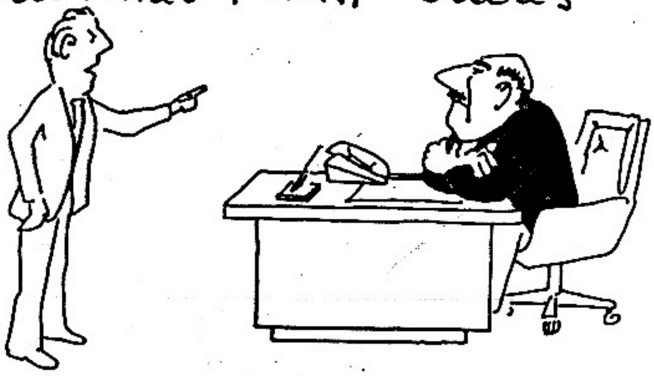
Computers and Intractability
A Guide to the Theory of NP-Completeness
(Freeman and Company)

I. Der ungebildete Angestellte



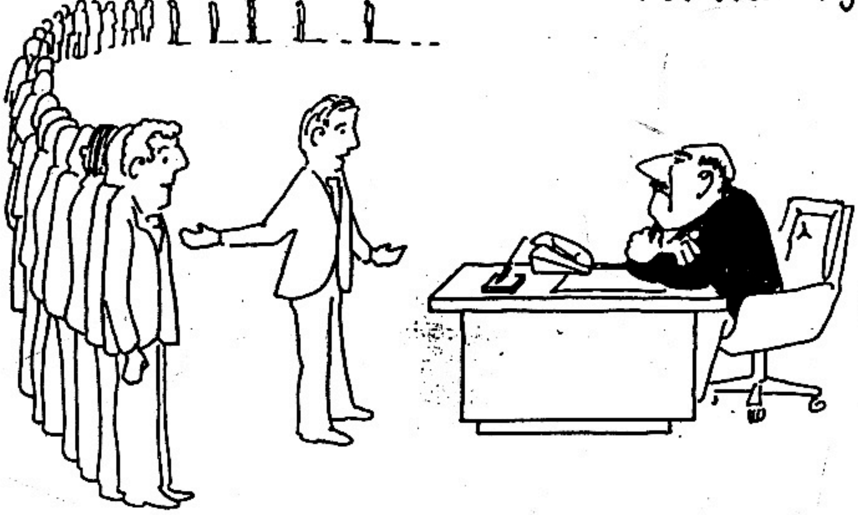
"I can't find an efficient algorithm, I guess I'm just too dumb."

II. Der Angestellte mit $P \neq NP$ Beweis



"I can't find an efficient algorithm, because no such algorithm is possible!"

III. Der Angestellte mit NP-Vollständigkeitsbeweis



"I can't find an efficient algorithm, but neither can all these famous people."

P	NP-complete
SHORTEST PATH BETWEEN TWO VERTICES INSTANCE: Graph $G=(V,E)$, length $l(e) \in Z^+$ for each $e \in E$, specified vertices $a,b \in V$, positive integer B. QUESTION: Is there a simple path from a to b in G having total length B or less?	**LONGEST PATH BETWEEN TWO VERTICES** INSTANCE: Graph $G=(V,E)$, length $l(e) \in Z^+$ for each $e \in E$, specified vertices $a,b \in V$, positive integer B. QUESTION: Is there a simple path from a to b in G having total length B or more?
EDGE COVER INSTANCE: Graph $G=(V,E)$, positive integer K. QUESTION: Is there an $E' \subseteq E$ with $\lvert E' \rvert \leqslant K$ such that for each $v \in V$ there is some $e \in E'$ for which $v \in e$?	**VERTEX COVER** INSTANCE: Graph $G=(V,E)$, positive integer K. QUESTION: Is there a $V' \subseteq V$ with $\lvert V' \rvert \leqslant K$ such that for each $e \in E$ there is some $v \in V'$ for which $v \in e$?
TRANSITIVE REDUCTION INSTANCE: Directed graph $G=(V,A)$, positive integer K. QUESTION: Is there an $A' \subseteq V \times V$ with $\lvert A' \rvert \leqslant K$ such that for all $u,v \in V$ $G'=(V,A')$ contains a path from u to v if and only if G does?	**MINIMUM EQUIVALENT DIGRAPH** INSTANCE: Directed graph $G=(V,A)$, positive integer K. QUESTION: Is there an $A' \subseteq A$ with $\lvert A' \rvert \leqslant K$ such that for all $u,v \in V$ $G'=(V,A')$ contains a path from u to v if and only if G does?
INTREE SCHEDULING INSTANCE: Set T of unit length tasks, deadline $d(t) \in Z^+$ for each $t \in T$, partial order $<$ on T such that each task has at most one immediate successor, positive integer m. QUESTION: Can T be scheduled on m processors to obey the partial order and meet all the deadlines?	**OUTTREE SCHEDULING** INSTANCE: Set T of unit length tasks, deadline $d(t) \in Z^+$ for each $t \in T$, partial order $<$ on T such that each task has at most one immediate predecessor, positive integer m. QUESTION: Can T be scheduled on m processors to obey the partial order and meet all the deadlines?

Figure 4.1 Pairs of similar problems, one belonging to P and the other NP-complete.

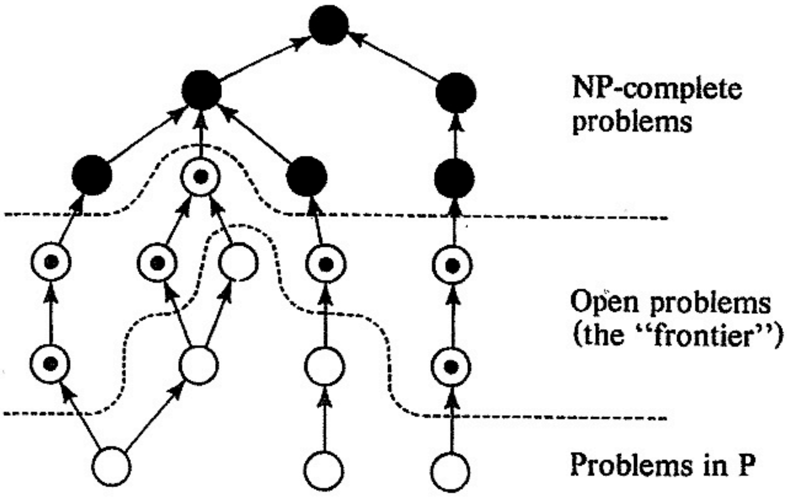


Figure 4.2 One possible state of knowledge about subproblems of an NP-complete problem Π. Problems are represented by circles, filled-in if known to be NP-complete, empty if known to be in P, and dotted if "open." An arrow from Π_1 to Π_2 signifies that Π_1 is a subproblem of Π_2.

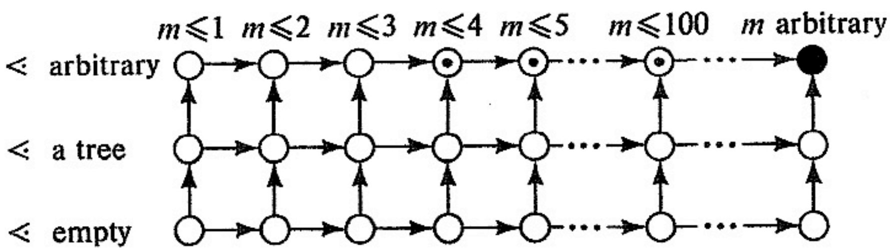


Figure 4.3 Current state of knowledge for a collection of subproblems of PRECEDENCE CONSTRAINED SCHEDULING, using the key given in Figure 4.2.

„Gadgets" für das Färbungsproblem

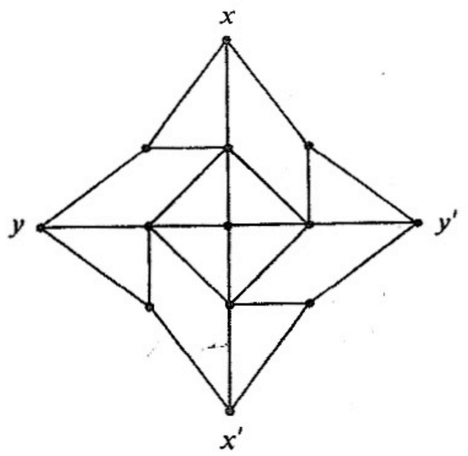


Figure 4.6 Crossover H used in the NP-completeness proof for PLANAR GRAPH 3-COLORABILITY.

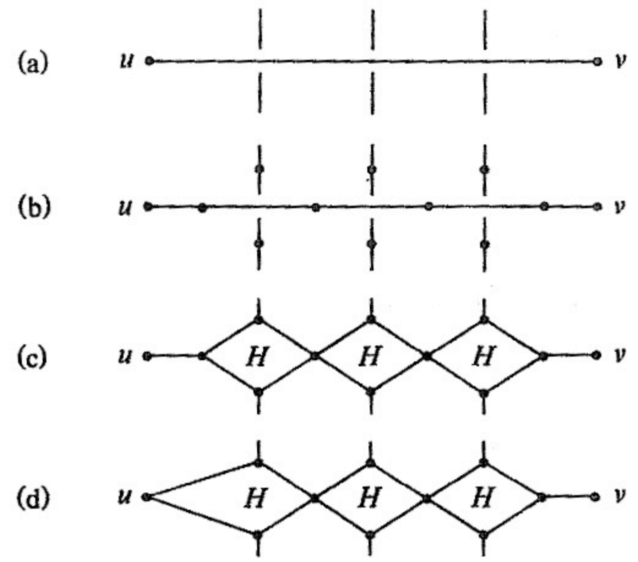


Figure 4.7 The construction of a planar graph G' from a given graph G, using the crossover H of Figure 4.6, so that 3-colorability is preserved.

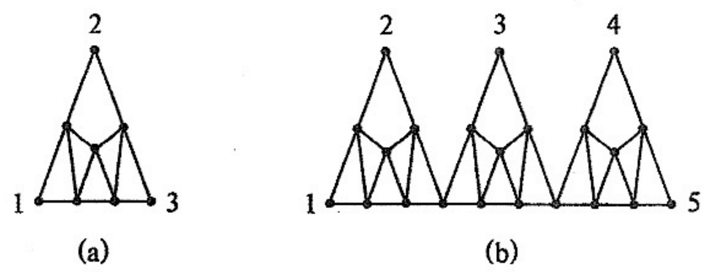


Figure 4.5 The graph H_3 and vertex substitute H_5 (formed from three copies of H_3) used for proving the NP-completeness of degree-restricted GRAPH 3-COLORABILITY.